
Education

2018 — Now **Computer Science, Doctor of Philosophy**, Boston University, Boston, MA

Primary Interest: Algebra Method in Program Analysis

I am broadly interested in application of mathematics in computer science, especially in programming languages. I have worked on Kleene algebra, program logics, semantics, type systems, and category theories.

2021 **Oregon Programming Language Summer School (OPLSS)**, University of Oregon, Eugene, OR

I have attended courses involving verification of probabilistic programs, session type for concurrent programming, and categorical semantics of advanced type systems, etc.

2014 — 2018 **Mathematics, Bachelor of Art**, with department honor, magna cum laude, Wheaton College, Norton, MA

Honor Thesis: King in Generalized Tournaments.

Minors: Computer Science, Economics.

2016 — 2017 **Economics, Study Aboard**, London School Of Economics, London, United Kingdom

Publications And Preprints

2022 **Mark Lemay, Qiancheng Fu, Cheng Zhang, William Blair, Hongwei Xi**, *A Dependently Typed Language with Dynamic Equality*, Submitted to International Conference On Functional Programming (ICFP)

2022 **Cheng Zhang, Arthur Azevedo de Amorim, Marco Gaboardi**, *On Incorrectness Logic and Kleene Algebra With Top and Tests*, Principle Of Programming Language (POPL)

2020 **Mark Lemay, Cheng Zhang, William Blair**, *Developing a Dependently Typed Language with Runtime Proof Search (Extended Abstract)*, Workshop on Type-Driven Development (TyDe)

2018 **Cheng Zhang**, *King in Generalized Tournaments*, Wheaton College Honor Thesis

2018 **Cheng Zhang, Weiqi Feng, Emma Steffens, Alvaro de Landaluce, Scott Kleinman, Mark D. LeBlanc**, *Lexos 2017: Building Reliable Software in Python*, Journal of Computing Sciences in Colleges

Research Talks

- 2022 **Cheng Zhang**, *Kleene Algebra and Its Applications in Verification*, Boston Computation Club
- 2022 **Cheng Zhang**, *On Incorrectness Logic Kleene Algebra With Test*, Cornell Programming Language Discussion Group (PLDG)
- 2022 **Cheng Zhang**, *On Incorrectness Logic Kleene Algebra With Test*, Principle Of Programming Languages (POPL)
- 2018 **Cheng Zhang, Mark D. LeBlanc**, *Lexos 2017: Building Reliable Software in Python*, Journal of Computing Sciences in Colleges
- 2018 **Cheng Zhang**, *Kings in Quasi-transitive Oriented Graph*, Wheaton Summit For Woman In STEM

Research Projects

- 2021 — Now **Probabilistic Kleene Algebra**, *Boston University*, Boston, MA
Examine the mathematical foundation of probabilistic Kleene Algebra and its potential application in analysis of probabilistic programs. This work may give rise to a unified approach to analysis probabilistic programs, provide ways to prove program correctness, and identify the probability to encounter bugs in probabilistic programs.
- 2020 — 2022 **Algebraic Formulation Of Incorrectness Logic**, *Boston University*, Boston, MA
Provide a algebraic formulation of Incorrectness Logic in TopKAT. Our work leads to simpler proofs for program incorrectness, and demonstrates ways to automatically certify bugs in programs. We showed that TopKAT is a minimal framework to model incorrectness, as it is impossible to encode incorrectness logic in KAT. After that, we proved many meta-theoretical property of TopKAT, including incompleteness with relational model, completeness of general relational model and language model, complexity of deciding equality, and expressivity of general relational model.
- 2017 — 2018 **Mathematics Honor Thesis**, *Wheaton College*, Norton, MA
Studied kings in generalizations of tournament, with a special focus on quasi-transitive oriented graphs. I have shown that all the quasi-transitive oriented graphs can be condensed into a tournament via tie component condensation, and tie component condensation of quasi-transitive oriented graphs is the most efficient condensation to tournament.
- 2015 — 2018 **Software Lead**, *Lexomics Research Group*, *Wheaton College*, Norton, MA
Led a group of undergraduate engineers through a major factorization of the natural language processing (NLP) software Lexos. In the process, I have designed a new architecture for side-effect management, transitioned the code base to a scalable functional-first paradigm, implemented industry-standard software development workflows, and provided detailed documentations and guides for the entire system.

Honors And Fellowships

- 2022 Meta PhD Research Fellowship Finalist in Programminag Languages
- 2018 — Now Phi Beta Kappa Honor Society Member.
- 2018 Boston University Dean's Fellowship.
- 2018 Phi Beta Kappa Graduate Scholarship.
- 2018 Madeleine F. Clark Wallace Mathematics Prize.
- 2018 Fred Kollett Prize in Mathematics & Computer Science.
- 2017 Weaton College Faculty-Student Research Awards.
- 2016 Wheaton Fellows.
- 2014 — 2018 Wheaton College International Scholarship.
- 2014 — 2018 Wheaton College Dean's Lists.

Technical Skills

Programming: Haskell, Ocaml, ATS, Python, TypeScript.

Formal Methods: Coq, Lean, MathComp Z3, EasyCrypt, Agda.

Data Processing: Panda, Scikit-Learn, Numpy, R.

Tools: Git, L^AT_EX, SSH, Jupyter Notebook.

Professional Experiences

- 2019 — Now **Graduate Researcher**, *Boston University*, Boston, MA
Study various extensions of Kleene Algebra, and their use in program analysis of imperative/functional programs, probabilistic programs, distributed systems, networks, etc. My researches provide easier, even automated, proofs for program analysis.
- 2019 — 2021 **Teaching Fellow**, *Boston University*, Boston, MA
Taught Principle of Programming Language, Introduction to Computer Science, Algebra Algorithm, Geometric Algorithm, etc.
- 2021 — Now **Organizer**, *Principle of Programming and Verification Seminar*, Boston University, Boston, MA
Invite seminar speakers and coordinate time of the talks; maintain seminar webpage, mailing list, and calendar; distribute details of the seminar to participants every week; and host speakers during the seminars.
- 2020 — Now **Organizer**, *Programming Language Reading Group*, Boston University, Boston, MA
Identify and distribute weekly reading materials; host and schedule the weekly discussions.

2019 **Grader**, *Boston University CS 511 Formal Method*, Boston, MA

Provided solutions to homework problems, graded the homework, organize useful statistics for the professor, and provided hints and answered questions piazza when necessary.

2017 — 2018 **Grader**, *Wheaton College MATH 241 Theory of Probability*, Norton, MA

Graded homework, gave feedback to students on each individual homework, and provide informative statistics to the professor on the homework.

Selected Coursework

2018 — Now **Computer Science, Doctor of Philosophy**, Boston University

- Computer Network
- Formal Method
- Overview On Type Systems
- Cryptography
- Compilers
- Complexity Thoery

2014 — 2018 **Mathematics, Bachelor of Art**, Wheaton College

- Complex Analysis
- Graph Thoery
- Mathematical Statistics
- Real Analysis
- Theory Of Computation
- Advanced Cryptography

2016 — 2017 **Economics, Study Aboard**, London School Of Economics

- Game Thoery
- Abstract Algebra I
- Econometrics
- Abstract Algebra II